2814 AF

#13/C(AE)
12/19/01
Surles

BOX AF

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of:

AKAMATSU et al.

1-23-02
Surles

Serial No.: **09/392,722** Group Art Unit: **2814**

Filed: **September 9, 1999** Examiner: **D. Graybill**

For: **INTEGRATED ELECTRONIC DEVICE HAVING FLIP-CHIP CONNECTION WITH CIRCUIT BOARD AND FABRICATION METHOD THEREOF**

AMENDMENT AFTER FINAL REJECTION

BOX AF
Commission for Patents
Washington, D. C. 20231

December 14, 2001

Sir:

In response to the Office Action dated September 14, 2001, please amend the above-identified application as follows:

IN THE SPECIFICATION:

Please amend the specification as follows:

At page 15, line 14, please insert the following newly added paragraph:

Thus, the present invention provides a method for fabricating an integrated electronic device having an electric connection between a first electrode of a first substrate and a second electrode of a second substrate comprising the steps of:

forming a first metal layer on a surface of a first electrode on a first substrate, the first metal

layer capable of composing an eutectic alloy with a gallium (Ga);

forming a bump of Ga-rosin mixture on the first metal layer selectively; and

forming the electric connection between the first electrode and the second electrode by heating the bump of Ga-rosin mixture maintaining the bump of the Ga-rosin mixture in contact with the second electrode to react gallium in the Ga-rosin mixture with the first metal layer into the alloy capable to adhere to the first and second electrodes. In this method for fabricating an integrated electronic device, the first metal layer is selected from the group consisting of tin, indium, silver, and zinc.

IN THE CLAIMS:

Please amend claims 39 and 41 as follows:

39. (Amended) A method for fabricating an integrated electronic device having an electric connection connecting a first electrode of a first substrate with a second electrode of a second substrate, surfaces of the first and the second electrodes having repellant and adhesive tendencies to molten metal, respectively, the method comprising the steps of:

forming first and second soldering metal bumps on the surfaces of the first and second electrodes by depositing first and second soldering metals through first and second masks, respectively, a melting temperature of the first soldering metal bump being higher than a melting temperature of the second soldering metal bump;

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aligning the first and second soldering metal bumps to each other, and then keeping both in contact with each other; and

heating the first and second soldering metal bumps to melt the second soldering metal bump at a connection temperature lower than the melting temperature of the first soldering metal bump and solidifying the second soldering metal to form an electric connection between the first and second electrodes.

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41. (Amended) A method for fabricating an integrated electronic device according to claim 39, wherein the first and second soldering metal bumps essentially consist of an alloy of Pb and Sn, wherein Pb is contained less in the first soldering metal bump than in the second soldering metal bump.

REMARKS

Claims 17-21, 25, 26 and 37-41 are pending. Applicants propose amendment of the specification and claims 39 and 41. A marked-up version showing the proposed changes is attached hereto as "**VERSION WITH MARKINGS TO SHOW CHANGES MADE.**"

The Examiner again objects to the amendment of September 9, 1999, as adding new matter on page 15, last line. In response to applicants' prior arguments, the Examiner argues in the first paragraph on page 7 of the Office Action that the first metal layer being silver is not supported by the original disclosure of the priority application no. 08/504,080. This application corresponds to the originally filed parent application.

Application Serial No. 08/504,080 contained two claim 23s, the first of which provided support for silver. The copy of the present application is identical with that of U. S. Serial No. 08/504,080. Thus, contrary to the Examiner's assertion, the priority application no. 08/504,080 does provide support for the amendment of page 15, last line.

It is noted, however, that the original claim 23 contained an obvious clerical error in that "according to claim 21" should have been "according to claim 22." More specifically, claim 21 does not have "the first metal" as recited in claim 22, whereas claim 22 does require the first metal.

Accordingly, applicants propose amendment of the specification to add the language of original claims 22 and 23. As such, the above amendment of the specification does not raise new issues or introduce new matter, and would fully support the claimed invention.

The Examiner also objects to the amendment filed on December 26, 2000 as introducing new matter. The Examiner considers the phrase "through the first and second masks" in claim 39 and the phrase "wherein the first and second soldering metal bumps essentially consist of Pb and Sn" in claim 41 as not being supported by the original specification.

Referring to "first and second masks" in claim 39, Figs. 4A-4E and page 10, lines 3-15, provide support for a metal mask 31 (line 3) and a metal mask (line 15) respectively corresponding to the first and second masks. As such, "first and second masks" in claim 39 is fully supported.

Referring to "wherein the first and second soldering metal bumps essentially consist of Pb and Sn, the description from page 7, line 23 through page 9, line 4 and Figs. 1A-2B provide support. More specifically, the specification discusses a preferred mixing ratio for the first and second soldering metal bumps as Pb-5%(wt) Sn and Pb 65%(wt) Sn. However, in order to further prosecution, applicants propose amendment of claim 41 to state an alloy of Pb and Sn.

Claims 39-41 were rejected under 35 USC § 112, first paragraph. This rejection is related to the new matter objection discussed above. For all the reasons discussed above, it is respectfully submitted that claims 39-41 are in compliance with 35 USC § 112, first paragraph.

Claims 39-41 were rejected under 35 USC § 112, second paragraph, as being indefinite. Amendment of claim 39 is proposed to change "the first and second masks" to --first and second masks-- so as to provide sufficient antecedent basis.

Accordingly, it is believed that the proposed amended claims are in full compliance with 35 USC § 112.

Claims 39-41 were rejected under 35 USC § 103(a) as being unpatentable over the combination of newly cited ***Behun*** and ***Hideshima***. Favorable reconsideration of this rejection is earnestly solicited.

The Examiner acknowledges that ***Behun*** does not explicitly teach that the first electrode has repellant tendencies to molten metal. However, the Examiner argues that since ***Hideshima*** discloses an electrode having repellant tendencies to molten metal, it would have been obvious to have modified ***Behun*** to employ a first electrode having repellant tendencies and a second electrode having adhesive tendencies to molten metal. Applicants respectively disagree.

The mere fact that ***Hideshima*** may disclose an electrode having repellant tendencies to molten metal would not have motivated one of ordinary skill in the art to modify ***Behun*** so that one electrode has adhesive tendencies and the other electrode has repellant tendencies. The Examiner's argument that the motivation would be to provide first and second electrodes does not carry weight since ***Behun*** discloses first and second electrodes. As such, the Examiner has failed to raise a prima facie case of obviousness.

Furthermore, in ***Hideshima***, the solder bump must be formed without melting the first bump as disclosed in its claim 1. Otherwise, the corrosion or the absorption phenomena can not be avoided. On the other hand, in ***Behun***, a solder ball 18 should not be melted when the connection is formed. In other words, a melting point of the first bump must be higher than that of the second bump and the connection temperature must between the first and second melting points.

In contrast, there is no limitation which melting point should be higher between the first and second bumps in the present invention because a eutectic alloy is utilized. Therefore, no attention is paid to repellant and/or adhesive tendency between metals and molten solders and also a eutectic alloy between different soldering metals in either of the cited references. Thus, there is no suggestion to combine a first electrode having repellant tendency to molten solder and the second electrode having adhesive tendency to molten solder.

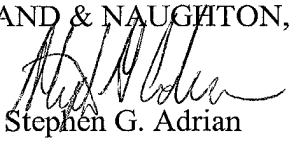
For at least the foregoing reasons, the claimed invention distinguishes over the cited art and defines patentable subject matter. Favorable reconsideration is earnestly solicited.

Should the Examiner deem that any further action by applicants would be desirable to place the application in condition for allowance, the Examiner is encouraged to telephone applicants' undersigned attorney.

In the event that this paper is not timely filed, applicants respectfully petition for an appropriate extension of time. The fees for such an extension or any other fees which may be due with respect to this paper, may be charged to Deposit Account No. 01-2340.

Respectfully submitted,

ARMSTRONG, WESTERMAN, HATTORI,
McLELAND & NAUGHTON, LLP



Stephen G. Adrian
Attorney for Applicants
Reg. No. 32,878

Attachment: Version with markings to show changes made

Atty. Docket No. **950637B**
1725 K Street, N.W., Suite 1000
Washington, DC 20006
Tel: (202) 659-2930
Fax: (202) 887-0357
SGA/arf